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Moore, Leeches of the U. S. National Museum.



SMITHSONIAN INSTITUTION.
UNITED STATES NATIONAL MUSEUM.

THE LEECHES OF THE U. S. NATIONAL MUSEUM.

BY

J. PERCY MOORE,
Instructor in Zoology, University of Pennsylvania.

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(with Plate XL).

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THE LEECHES OF THE U. S. NATIONAL MUSEUM.

By J. PERCY MOORE,

Instructor in Zoology, University of Pennsylvania.

Through the courtesy of the curators the collection of leeches contained in the U. S. National Museum has been placed in my hands for study and determination. Though small, and much of it poorly preserved, the collection has proved an interesting one. None of the forms had previously been identified; several have been found to be undescribed, several others have been mentioned in the literature but once or twice, and many are here recorded from new localities more or less remote from those previously known. The material has been drawn from various parts of the world, but it is to be regretted that our own American leeches are so poorly represented. Our fauna is a rich one, but is, perhaps, well known to but one person, who has as yet shared but little of his knowledge with the scientific public. We are still in nearly complete ignorance of the number and distribution of the species, and many interesting morphological questions remain to be elucidated. But one attempt has been made to systematize our knowledge—that of Prof. A. E. Verrill twenty-five years ago—and that upon very inadequate material from comparatively few localities. It is to be hoped that a greater interest will be taken in making well-preserved collections, and that our National Museum will soon have gathered together a complete series, not alone of leeches, but of annelids generally and other worms as well.

This is perhaps not the most suitable occasion to enter upon a discussion of any of the broader or more theoretical problems of morphology upon which the collection throws light. There is, however, one matter of especial interest to the systematic student to which some reference may profitably be made. I refer to the annulation of the somite. My observations on this subject accord perfectly with the views expressed by Whitman (5 and 6) and later by Lang (4) and Blanchard for the Glossiphoniidæ, Hirudinidæ, and Herpobdellidæ, and I am pleased to be able to extend them to the Ichthyobdellidæ also, which has, I believe, not previously been done. Apathy (1), who has made the most important recent contributions to the external morphology of the latter family, takes a precisely opposite view to that of

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Whitman. He regards the multi-annulate somite as primitive. The view here supported is that the primitive typical leech somite consisted of three annuli. These primary annuli can readily be recognized in all families and most species of leeches which I have examined. When the primitive tri-annulate character of the somite is lost this may take place by (*a*) reduction, which has occurred as a result of coalescence of the primary rings at the anterior and posterior ends of nearly all leeches and in the genital regions of some, or (*b*) by elaboration, which has taken place in the somites of the middle body region, especially of the Gnathobdellidæ, Herpobdellidæ, and Ichthyobdellidæ. The increase in the number of annuli by which this elaboration is expressed externally seldom if ever occurs by the actual intercalation of new rings, but only by the growth and lesser or greater subdivision of the three primary rings. This subdivision seems to follow a regular law, which is that any number or all of the primary rings may become secondarily bi-annulate, the secondary annuli similarly biannulate and the tertiary again divided for the fourth time, and any one of these subdivisions may be in various degrees partial or complete, and may affect one or more annuli of any order. The theoretical completeness of the process is expressed in the following table, which also presents a system of nomenclature for the maximum possible number of annuli of each order, up to the fourth, of a complete somite, enabling the structure of a typical somite of any genus to be expressed by a simple formula.

Table of annulations.

First order.	Second order.	Third order.	Fourth order.
Somite. <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> $\left. \begin{array}{c} a1 \\ a2 \\ a3 \end{array} \right\}$ </div> <div> $\left. \begin{array}{c} b1 \\ b2 \\ b3 \\ b4 \\ b5 \\ b6 \end{array} \right\}$ </div> <div> $\left. \begin{array}{c} c1 \\ c2 \\ c3 \\ c4 \\ c5 \\ c6 \\ c7 \\ c8 \\ c9 \\ c10 \\ c11 \\ c12 \end{array} \right\}$ </div> <div> $\left. \begin{array}{c} d1 \\ d2 \\ d3 \\ d4 \\ d5 \\ d6 \\ d7 \\ d8 \\ d9 \\ d10 \\ d11 \\ d12 \\ d13 \\ d14 \\ d15 \\ d16 \\ d17 \\ d18 \\ d19 \\ d20 \\ d21 \\ d22 \\ d23 \\ d24 \end{array} \right\}$ </div> </div>	b1	$\left\{ \begin{array}{l} c1 \\ c2 \end{array} \right.$	$\left\{ \begin{array}{l} d1 \\ d2 \end{array} \right.$
	b2	$\left\{ \begin{array}{l} c3 \\ c4 \end{array} \right.$	$\left\{ \begin{array}{l} d3 \\ d4 \end{array} \right.$
	b3	$\left\{ \begin{array}{l} c5 \\ c6 \end{array} \right.$	$\left\{ \begin{array}{l} d5 \\ d6 \end{array} \right.$
	b4	$\left\{ \begin{array}{l} c7 \\ c8 \end{array} \right.$	$\left\{ \begin{array}{l} d7 \\ d8 \end{array} \right.$
	b5	$\left\{ \begin{array}{l} c9 \\ c10 \end{array} \right.$	$\left\{ \begin{array}{l} d9 \\ d10 \end{array} \right.$
	b6	$\left\{ \begin{array}{l} c11 \\ c12 \end{array} \right.$	$\left\{ \begin{array}{l} d11 \\ d12 \end{array} \right.$
			$\left\{ \begin{array}{l} d13 \\ d14 \end{array} \right.$
			$\left\{ \begin{array}{l} d15 \\ d16 \end{array} \right.$
			$\left\{ \begin{array}{l} d17 \\ d18 \end{array} \right.$
			$\left\{ \begin{array}{l} d19 \\ d20 \end{array} \right.$
			$\left\{ \begin{array}{l} d21 \\ d22 \end{array} \right.$
			$\left\{ \begin{array}{l} d23 \\ d24 \end{array} \right.$
Total. 3	6	12	24

I give a few illustrations of the application of the system. *Protolepsine* and many other Glossiphonidæ have a simple tri-annulate somite $a1 + a2 + a3$. Many of the larger species of *Glossiphonia* show a slight subdivision of the second and third primary annuli, which becomes strongly expressed in *Hæmentaria*, $a1 + a2 (b3 b4) + a3 (b5 b6)$.

In the Hirudinidæ generally this tendency is complete, and the five annuli resulting are practically equivalent so far as size, etc., is concerned, $a1 + b3 + b4 + b5 + b6$ or $a1 + b3-6$. *Trachellobdella* has all three of the primary annuli subdivided, thus: $b1 + b2 + b3 + b4 + b5 + b6$ or more simply $b1-6$. But in some of the species the divisions are incomplete, while in others those of the third order have set in, facts which may be expressed by the use of brackets, as shown above for *Hæmentaria*. In *Dina* the third actual (fourth secondary) annulus is widened and distinctly bi-annulate, expressible thus: $a1 + b3 + b4$ ($c7$ $c8$) $+ b5 + b6$. The greatest complexity is found among the Ichthyobdellidæ, of which *Cystobranchus* has the six secondary annuli, the third or sometimes the fourth being subdivided. $b1 + b2 + c5 + c6 + b4 + b5 + b6$ or $b1-2 + c5-6 + b4-6$. *Piscicola* varies somewhat, but the most frequent arrangement is that in which the full number of annuli of the third order is developed, and two of these, namely, $c5$ and $c8$, are divided into annuli of the fourth order, making in all fourteen annuli, expressed by the formula $c1-4 + d9 + d10 + c6 + c7 + d15 + d16 + c9-12$. In some species the fourteen annuli become perfectly equivalent in size and the plan of their formation obscure. No cases are known in which the whole twenty-four of the possible annuli of the fourth order are developed, or in which annuli of the fifth order are more than very slightly indicated.

Partial or complete unions of adjacent annuli of neighboring somites frequently occur, and possibly entire somites may be absorbed, or simulations of new ones formed in the prostomial region. All of these conditions can be expressed in the formula, which could also be adapted to indicate whether any given condition has arisen by simplification or elaboration. The desirability of some more exact method of defining the annulation of the Ichthyobdellidæ must be obvious to anyone who has noted the great confusion which reigns in this group as to the number of annuli of each somite, and the scope of the genera. Different authors have each usually attended to but one of the several orders of division of the somite, and thus we have *Piscicola* (*Ichthyobdella*) described with seven, twelve, or fourteen rings, each of which expresses a part of the truth.

By combining the somite formula with the Roman numerals by which the individual somites are indicated, we can describe any annulus desired with the greatest precision. As to the order of the elaboration of the annuli in the Ichthyobdellidæ I have little light, except that the process begins in the middle primary annulus, and there also proceeds the farthest. There are good physiological and mechanical reasons for this; but I hope soon to have sufficient data for a fuller discussion of the external morphology of this family. This preliminary account is presented here in the hope that students of the Hirudinea will find this scheme of sufficient value to test and perfect it. The systematic portion of the paper follows.

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Family GLOSSIPHONIDÆ.

PROTOCLEPSINE, new genus.

This genus exhibits primitive external characters in the retention of the full number (3) of annuli in all of the anterior somites, and in the elevation of the eyes upon papillæ which stand in serial relation to the dorsal median segmental papillæ of the succeeding somites. The sexual pores occupy the usual positions in somites X and XI.

The type species has three pairs of eyes situated on somites I, II, and III; and the posterior somites XXII to XXVI are reduced.

1. PROTOCLEPSINE SEXOCULATA, new species.

(Plate XL, fig. 1.)

Unfortunately there is but a single much contracted specimen of this interesting species. The prostomium is curled ventralward and the specimen is probably immature, so that the following measurements have a relative value only:

	mm.
Length	5.1
Greatest width (XIXth somite)	2.5
Depth at somite XIX	1.2
Width at genital region	2.2-2.4
Depth at genital region	About 1
Diameter of acetabulum	1.5

In its contracted condition the body is truncated at both ends, the prostomium being curled under at the anterior end (corrected in the drawing, fig. 1), and the acetabulum drawn closely up at the posterior end. Consequently the body appears almost quadrate, with its greatest width far back. It is strongly convex above and slightly concave below. The acetabulum is large and circular, with thickened margins. The anterior sucker is wide, with thickened crenulated margins, formed posteriorly by annulus 5; its interior and the mouth opening are hidden by the infolded prostomium. A deep median and three pairs of small lateral sulci divide the free margin of the prostomium into eight lobes, of which the four middle ones bear as many small papillæ. Dorsally it consists of a larger anterior and a smaller posterior annulus.

The somites I to XXI, inclusive, are complete, each consisting of three annuli; XXII and XXIII are biannulate; XXIV and XXV biannulate at the margins and undivided mesially; and XXVI consists of a single annulus. On each side of the middle line are three series of dorsal and four series of ventral papillæ, situated on the first annulus of each somite on which alone papillæ are evident. Of the dorsal series the innermost are widely separated, leaving a broad median area; the outermost are supra-marginal, and the remaining series halfway between these. All of the papillæ are smooth and rather inconspicuous. On the first, fourth and seventh rings behind the prostomium

the papillæ of the innermost dorsal series are transformed into deeply pigmented eyes, but still retain their character as papillæ, being quite as elevated as the succeeding members of the series, with which they continue in perfect serial relation of position. Were any further evidence required to demonstrate Whitman's view of the homology of the eyes and segmental papillæ of leeches, this species would supply it. Annuli one and four lack the marginal but retain the intermediate papillæ. The former begin on annulus seven and continue to somite XXV. The intermediate series ceases at somite XXIII, while the innermost continues to the post-anal annulus.

The ventral papillæ begin on annulus seven, which is united with six. They are a marginal, a mesial ventral, and two intermediate on each side. The most mesial pair are widely separated and about opposite to the mesial dorsal series. All are small, and in this specimen can be detected with certainty on only a portion of the somites.

The individual described is probably immature, as the genital pores, although not difficult to detect, are very small, and their lips not swollen or glandular. The male pore is situated between annuli twenty-nine and thirty and the female between thirty-one and thirty-two. The color is probably much changed in preservation, being a nearly uniform bronze-brown. The eyes are black. Nothing is known of the internal anatomy.

Type.—No. 4320, U.S.N.M. Bering Island, Commander Islands, Siberia. Leonhard Stejneger, August 5, 1882, No. 1405. One specimen.

GLOSSIPHONIA Johnson.

2. GLOSSIPHONIA MOLLISSIMA.

(Plate XL, fig. 2.)

Clepsine mollissima GRUBE.

This species was described by Grube (3) from specimens collected at Lake Baikal, Siberia. The following notes will serve to supplement Grube's description. The first pair of eyes are very small, deeply set, and sometimes united to the second pair. They appear to be undergoing degeneration and absorption. The annulation of the first four somites is shown in the following table:

Annulation of somites of Glossiphonia mollissima.

Somite.	Annuli.	Organ.
I.....	1} <i>Prostomium.</i>	First pair of eyes.
II.....	2} partly united.	Second pair of eyes.
III.....	3} united.	Third pair of eyes.
IV.....	4} united.	
	5} united.	
	6} united.	
	7	
	8	

The prostomium consists of a single partial ring. The united third and fourth rings form the posterior margin of the anterior sucker. Somites III to XXII are complete, XXIII consists of annuli sixty-three and sixty-four, XXIV of sixty-five, which is double at the margins, XXV of sixty-six and XXVI of sixty-seven, behind which is the anus. The male pore is placed at $Xa\frac{2}{3}$, or between the annuli twenty-five and twenty-six; the female at $XIa\frac{1}{2}$, or between twenty-seven and twenty-eight.

Character is given to the papillation by the great development of the dorsal median series, the papillæ of which are very large, and in some specimens the only ones distinctly developed. They become conspicuous on annulus fifteen, and are found on the first annulus of every complete somite thereafter, and on the annuli sixty-three, sixty-five, sixty-six, and sixty-seven. In the best preserved material they may be traced as far forward as annulus six. The mates are separated at the middle line by about one-fourth of the width of the body. The dorsal inner-lateral papillæ are also well marked on most specimens, and are found on the eye-bearing annuli, as well as on all those bearing the dorsal median ones. The outer lateral papillæ have become reduced to almost total suppression and were unnoticed by Grube. Very minute members of this series may usually be found on the eye-bearing and several succeeding papilliferous annuli. Besides the serial papillæ, very minute variable ones are found on the dorsum of all of the annuli. There are 10 or 12 small papillæ on the ventral surface of the first ring of each somite.

On the accompanying label Dr. Stejneger gives the following description of the colors of this species during life:

Olive green, margins more brownish, two series of large whitish knobs along the back, and several smaller and less conspicuous spots between these and the margins. Along the back a regular system of narrow brownish longitudinal stripes.

This species closely resembles the *Clepsine elegans* of Verrill, from which it may be distinguished by the much larger dorsal median papillæ.

No. 4259, U.S.N.M. Bering Island, Commander Islands, Leonhard Stejneger. 1882-83. Twenty-two specimens.

3. GLOSSIPHONIA PARASITICA.

Hirudo parasitica SAY.

Clepsine ornata VERRILL (in part).

I have not yet acquired sufficient material to satisfy myself of the status of Verrill's species of *Clepsine*; but it is certain that both *C. ornata* and *C. papillata* are composite and in part synonymous. The types should be again studied and compared. I think that the forms here included can safely be regarded as conspecific with those forming the basis of Verrill's original description of *Clepsine ornata*, and their identity with Say's species was established by the examination of the supposed types in the collection of the Philadelphia Academy of

Natural Sciences. The following examples are included in the U. S. National Museum collection.

No. 5025, U.S.N.M. Vicinity of Fort Huachuca, Arizona. Dr. T. E. Wilcox, U. S. A. Five specimens.

No. 4025, U.S.N.M. Currant River, Shannon County, Missouri. R. Ellsworth. One specimen.

No. 5026, U.S.N.M. Pine Ridge Agency, South Dakota. Dr. Leonard Stejneger, 1894. One specimen.

No. 823, U.S.N.M. North Red River, British America. R. Kennicott. One specimen.

No. 4694, U.S.N.M. Wheatland, Indiana. On *Chelydra serpentina*. Fourteen specimens.

No. 4602, U.S.N.M. Keel-Foot Lake, Obion County, Tennessee (from a small creek emptying into lake near Idlewild Hotel), May 30, 1882. E. Palmer. One specimen, very badly dried up and shrunken, but apparently a large example of this species.

No. 5027, U.S.N.M., 50 miles from Bluefields, Nicaragua. C. W. Richmond. On turtle. Five specimens.

4. GLOSSIPHONIA LINEATA.

Clepsine papillata VERRILL var. *lineata*.

In many respects this species resembles *G. triserialis* E. Blanchard, but differs from this and resembles *G. bridgei* O. F. Müller in the position of the genital pores, which are separated by but one annulus. The external male orifice is situated at $\frac{x}{xi}$, ($\frac{2}{5}$), the female at XI $a\frac{1}{2}$, ($\frac{2}{5}$), the latter being the usual position. The white patches which flank the black papillæ appear to be more conspicuously developed in the Mexican specimens, making this a very beautiful species.

No. 4101, U.S.N.M. D'eau douce de la Canada de Marfil, Mexico. Prof. A. Dugès, February 8, 1882. Nineteen adult and numerous young specimens.

5. GLOSSIPHONIA STAGNALIS.

Hirudo stagnalis LINNÆUS.

Clepsine modesta VERRILL.

This species is very common and widely distributed over the United States. No characters have been found which serve to distinguish it from the well-known European form.

No. 1038, U.S.N.M. Woods Hole, Massachusetts, September 16, 1883. William Nye, jr.; fresh-water ponds. Six specimens.

No. 808, U.S.N.M. Woods Hole, Massachusetts, September 24, 1883. William Nye, jr.; fresh-water pond. Many specimens.

PLACOBDELLA R. Blanchard.

6. PLACOBDELLA MEXICANA, new species.

(Plate XL, fig. 3.)

This species is close to *Placobdella plana* (Whitman) R. Blanchard, but the annulation differs in several respects. The body is broad and depressed, and rather ovoid in outline. The largest specimen measures 14.7 mm. in length and 6 mm. in breadth at the widest part. The acetabulum is small and weak, and about 2.5 mm. in diameter.

The prostomium is undivided. It is followed by a rather wide ring, which bears the single pair of eyes on its posterior part, and the first pair of dorso-inner-lateral papillæ on its anterior part. A plain narrow ring follows, then a broad double one bearing the second pair of dorso-inner-lateral papillæ on its anterior half. A narrow ring completes with this double one somite III. Somite IV is in one specimen similarly constituted of a broad double ring and a narrow one; in the others it is constructed like the following somites of three rings, the first of which bears papillæ. Somite XXII is the last complete one; XXIII has two annuli, XXIV a single annulus, double at the margin, and XXV and XXVI each a single papillate annulus. The male pore is situated between the twenty-fourth and twenty-fifth, the female pore between the twenty-sixth and twenty-seventh, and the anus between the sixty-sixth and sixty-seventh annuli.

The dorso-median and dorso-inner-lateral papillæ are large and conspicuous, but low, smooth, and rounded. The former begin on annulus eight (somite V) and continue with the latter to somite XXVI. The outer lateral are small; they begin on annulus eleven, the first of somite VI, and continue to annulus fifty-nine (somite XXII). The second annulus also of each somite of the middle region of the body bears six series of small papillæ which lie mesiad to the corresponding ones of the first annulus.

The color of the alcoholic specimens is a rich chocolate brown blotched with lighter and darker brown, a branched figure of the latter color corresponding very closely with the branches of the intestine, and the pale spots in general with the papillæ. A median white line appears at the anterior and posterior ends of the body. Beginning anteriorly in a triangular area which includes the eyes, it is more or less interrupted and broken at the first annulus of each somite to the seventh, where the band fades out. On the second annulus of each of these somites the pale area runs out laterad in transverse bars, which on V reach nearly to the margins of the body. At the posterior end a similar narrow pale area extends forward from the anus to somite XXI. Marginal white spots occur metamerically on each somite. The posterior sucker is marked with alternating rays of brown and white, the latter being confined mainly to the marginal half.

Types.—No. 5028, U.S.N.M. Mexico; P. G. Jouy; No. 384. Three specimens.

HÆMENTARIA De Filippi.

7. HÆMENTARIA OFFICINALIS De Filippi.

No. 1478, U.S.N.M. Guanajuato, Mexico; Prof. A. Dugès. Two specimens.

Family ICHTHYOBDELLIDÆ.

TRACHELOBDELLA Diesing.

8. TRACHELOBDELLA VIVIDUS.

(Plate XL, fig. 4.)

Cystobranchus vividus VERRILL.

This species bears a striking resemblance to a *Cystobranchus*, but the annulation and the position of the sexual pores are characteristically that recently attributed by Blanchard to *Trachelobdella*.

The two regions of the body are sharply distinguished. The anterior, which contains the first eleven somites, is somewhat sunken into and embraced by the first somite of the posterior region. Somites IX, X, and XI are narrowed to form the clitellum, in front of which the body is slightly expanded laterally. The anterior region includes twenty distinct primary annuli posterior to the expanded "head," which latter, with the first five annuli, constitute five somites. Somite VI is composed of three primary annuli, each of which is clearly biannulate. Somite VII is as large as the eight preceding annuli. Each of the primary annuli is divided into two and these again halved dorsally, so that twelve annuli of the third order may be counted on the dorsal side. The middle primary annulus (*a* 2) of this somite is large, and its two secondary annuli (*b* 3 and 4) have almost the value of the adjacent primary annuli. Somite VIII is similarly annulated, but shorter. The somites IX, X, and XI are the clitellar somites and are each reduced to two primary annuli, which, with the exception of the last, are obscurely biannulate. The male pore is located on the anterior margin of somite X, or between this and the preceding annulus (16). On the ventral side annuli sixteen and seventeen are much enlarged and partly fused with fifteen and eighteen, respectively. The female pore is between the eighteenth and nineteenth annuli, having the same relation to somite XI as the male pore has to X. The twentieth annulus is obscure, being united with and retracted within somite XI.

The posterior body region is broad and depressed, the transverse and vertical diameters being about as two to one. The constriction shown in the figure in the posterior third of the body is probably the result of an accident of preservation. The somites of this region are characterized by the six secondary annuli, those of the second primary annulus (*a* 2) being largest and on the dorsal side again divided into the tertiary annuli, thus: *b* 1-2 + *c* 5-6-7-8 + *b* 5-6. This latter character is lost in the posterior somites. Somite XXII is the last complete

one, behind which there are four additional obscurely biannulate pre-anal annuli.

There are eleven pairs of well-developed lateral vesicles, which diminish in size each way from the sixth. Behind the eleventh pair are two pairs of rudimentary vesicles, indicated by opaque whitish lateral thickenings of the rings. The well-developed vesicles occupy the sides of *b* 1 and *b* 2 of their somites, except the first, which extends onto the last ring of somite XI. There are indications of annulation of the anterior sucker, but too obscure in this specimen to be described.

No. 242, U.S.N.M. Woods Hole, Massachusetts; V. N. Edwards. One specimen.

9. *TRACHELOBDELLA MACULATA*, new species.

(Plate XI, fig. 6.)

The two body regions are well marked, the anterior slender and terete, the posterior broad, flattened, and raquet-shaped. The posterior sucker is small, little if at all directed ventralward, and is contracted to a slit-like opening.

There are thirteen pairs of respiratory vesicles, with a posterior rudimentary fourteenth. The anterior ones are indistinct and the largest (the ninth and tenth pairs) at the widest part of the body. This region is concave below and convex above from side to side. The anterior region is somewhat retracted within the posterior. The head (in the contracted specimen) is scarcely expanded, and its margin only slightly oblique. Its free margin tends to fold into four lobes, dorsal, ventral and two lateral.

As in most other species of the genus, the annulation of the anterior region is irregular and difficult of interpretation. In this specimen the difficulty is increased owing to the integument being gathered up at several spots, as it were, into loose tufts, which disturb the arrangement of the annuli. After a careful study I have fixed on the interpretation shown in the figure; but this needs to be confirmed by a study of more and better material. The clitellar region is sufficiently distinct. Six annulations are observable on the dorsal side of the head. Then follow two narrow rings in the constriction behind the head. Behind these follow, apparently, four complete somites (V to VIII) of three rings each, of which the first corresponds closely to the transverse bands of orange, the second and third to the ashy spots described below. The primary rings of somite VIII, as here provisionally identified, are subdivided into six secondary rings. The clitellum consists of the two primary partly orange-colored rings of somite IX, the two primary (divided into four secondary) uncolored rings of somite X, and the similarly constituted somite XI, of which the last ring is united with the first of somite XII. The male pore is between the two secondary rings of annulus seventeen (the first of somite X), and the female pore

between the two secondary rings of annulus nineteen (the first of somite XI). They are consequently separated by four small secondary annuli.

The somites of the posterior region are hexamerous, but the three primary annuli are easily recognized; and the first and second of each somite, except XII, are undivided at the margins, where they are occupied by the paired respiratory vesicles. The vesicles, as in the species to be described next, extend over the first and second primary rings of each somite, though in many cases the second is only partly occupied. Anteriorly the vesicles are collapsed and, except for their color, indistinct, but posteriorly they become much more prominent. Traces of a rudimentary fourteenth pair are found just anterior to the anus.

The color pattern of this species is interesting, and has probably been derived from the breaking up and partial shifting of an annular pattern, which still persists to some extent in the anterior region. The general color above is a rich bright orange anteriorly, becoming faded to a pale yellow posteriorly, where it extends over much of the ventral surface also. The ventral surface of the anterior region, the greater part of the clitellum, and the head are of a pale ashy color, which spots the dorsal surface also. These ashy spots show a distinct tendency to become arranged in three longitudinal rows on the posterior region. They are mostly large and of irregular shapes, and very nearly correspond to the somites, but those of the middle series have shifted more or less toward the posterior end and sometimes become confluent with neighboring blotches. All are edged by a very narrow border of reddish brown. A few similar irregular blotches are seen on the ventral surface. A small orange patch surrounds the male pore, and there is a similar one on each side of the clitellum. On each side of the dorsal surface of the head is a large bright orange spot, leaving a median ashy area. In the figure the orange-colored parts are stippled, the ashy plain. The hexamerous structure of the posterior somites is represented only in XIX and XX, but the others are similar.

The single specimen measures:

	mm.
Length	13.5
Greatest breadth.....	4.2
Length of anterior region.....	3
Breadth at male pore.....	.9
Breadth of anterior sucker.....	1
Diameter of posterior sucker.....	1.5
Depth of posterior region of body.....	1

Type.—No. 1314, U.S.N.M. Steamer *Albatross*. Locality unknown.

10. TRACHELOBDELLA RUGOSA, new species.

(Plate XL, fig. 5.)

The adult specimens of this species have the broad depressed form shown in the figure; a young individual is terete, with the vesicles appended to the sides of the body, and connected by a broad lateral cutaneous fold lodging the marginal sinus, by the metameric enlarge-

ment of which the vascular sacs of the vesicles are formed. The anterior region of the mature as well as of the young specimen is depressed, as in *T. maculata*, instead of terete, but the annulation, although obscured by cutaneous folds, appears to be the same. Exclusive of the three obscure annulations observable on the dorsum of the head there are twenty prevesicular annuli, of which the last is united with and retracted into the border of somite XII.

Three complete anteclitellar somites are recognizable, owing to the presence on their first and second primary rings (namely, six and seven, nine and ten, and thirteen and fourteen) of peculiar cutaneous projections just dorsal to their lateral margins. These are usually, but not invariably, united into a single pair on each somite, and are probably of the nature of rudimentary respiratory vesicles, or at least homodynamous structures. They lie somewhat dorsal to the plane of the functional vesicles.

The clitellum consists of two relatively large annuli, which are united together and bear a pair of cutaneous appendages in strictly marginal position, and four narrow biannulate annuli, of which the first contains the male and the third the female orifice, thus agreeing with *T. maculata*. The last, and frequently the female ring also, is contracted within the following somite.

In the posterior region the integument, which must have been very loose in life, is much wrinkled and thrown into folds in contraction. This condition is less marked in the young example, in which the three primary annuli are readily recognized, and the first and second are seen to be occupied by the remarkably large respiratory vesicles. Each of the primary annuli of the adults is marked by four more or less distinctly marked transverse folds, which are divided by longitudinal furrows, into quadrangular tile-like and slightly raised areas, giving to the entire surface a rugous tessellated appearance.

The respiratory vesicles are very large and conspicuous. They occupy the margins of the first and second primary annuli of each somite, and are connected by a cutaneous fold which is continuous along the margins of the body from the first to the twelfth or last pair of functional vesicles. Delicate irregular cutaneous wrinkles roughen the surface of both the vesicles and the marginal fold.

The posterior sucker is small, straight, and shallow; the anterior is closed in contraction to a vertical slit. No pigment remains in the bodies of any of the specimens, which have faded to a uniform clay color. A few brown pigment cells are arranged in a zone across the head anterior to the annulations. There are no eyes.

The specimen figured has the following measurements:

	mm.
Length complete.....	23
Length of anterior region.....	3.3
Width of clitellar region.....	1.3
Width at first pair of vesicles	2.4
Width at ninth pair of vesicles.....	5.8

Types.—No. 5035, U.S.N.M. From red snapper. Six specimens.

CYSTOBRANCHUS Diesing.

11. CYSTOBRANCHUS species?

No. 1594, U.S.N.M. *Albatross* station 2737. One specimen.

PISCICOLA Blainville.

The genus *Piscicola* as here used is composite and requires subdivision, but no adequate system has yet been proposed.

12. PISCICOLA GEOMETRA (Linnæus) Blainville.

No. 237, U.S.N.M. Washington, District of Columbia, February 3, 1883. On German carp (probably introduced with these fish). Three specimens.

13. PISCICOLA SEXOCULATA.

Platybdella sexoculata MALM.

No. 4850, U.S.N.M. St. Pauls Island, Bering Sea, June, 1890; William Palmer, from Sculpin. Five specimens.

14. PISCICOLA SCORPII.

Hirudo scorpii FABRICIUS.

Platybdella scorpii MALM.

Piscicola multistriata GRUBE.

No. 5029, U.S.N.M. St. Pauls Island, Bering Sea; William Palmer, June, 1890, from Sculpin. Six specimens.

No. 3944, U.S.N.M. From Sculpin. One specimen.

15. PISCICOLA ZEBRA, new species.

This species has the slender, somewhat depressed, nearly linear form of *P. geometra*, but the posterior sucker is nearly circular, and much less excentrically fixed, the anterior is smaller, the annulation shows some peculiarities, and the color is very different. In these specimens no respiratory vesicles are visible.

The anterior body region contains twenty-one primary annuli, of which the first five are undivided, six to fifteen are distinctly broader and biannulate, and the secondary rings often again biannulate, making four minor or tertiary rings to each primary annulus. Then begins the clitellar region with annuli sixteen to eighteen narrower and less distinctly biannulate. The male pore is in the posterior part of eighteen, and is bounded behind by a narrow fold. In contracted specimens this pore appears to be between eighteen and nineteen, owing to the suppression of the fold. Nineteen and twenty are similar, with the female pore behind the latter. Twenty-one and the following annuli are again distinctly and doubly biannulate. The posterior region begins with twenty-two.

The typical somites of the posterior region have fourteen annuli of the third and fourth orders; the first and third primary annuli have

four each, the second six of these, as shown in the formula $c1-4+d9-10+c6+c7+d15-16+c9-12$, and in some cases $d13$ and 14 are developed. The annuli from fifty-seven to sixty-three (the last), inclusive, become simplified and are either undivided or faintly biannulate. The anus is between sixty-one and sixty-two.

I describe the color somewhat fully. The pattern is made up of irregular and often confluent blotches of brown on a yellowish ground, disposed differently in each specimen, but with a strong tendency to assume the annular or banded arrangement in all, except on the middle dorsal region, where the inner portions of the brown spots tend to become confluent into a pair of longitudinal stripes separated by a narrow but conspicuous median yellow stripe. The head is characteristically colored. The anterior two-thirds is yellowish, the posterior third marked by a conspicuous band of dark brown which in the three larger specimens extends two-thirds of the way around and on the smallest only one-half, leaving an uncolored ventral area. Dorsally, the dark band is interrupted by a narrow median line of bright yellow. Two pairs of dark brown eyes (separated by two-thirds of the width of the head) are situated at the angles of a parallelogram whose anterior and posterior sides correspond with the boundaries of the dark band. The anterior eyes are the larger. In some of the specimens the angles of the band, where broken dorsally, show an intensification of the pigment, which in one specimen bears a superficial resemblance to two additional pairs of eyes. In all of the specimens the dark ring is succeeded by a pale one which occupies the last cephalic and first and second post-cephalic annuli. Then follow eighteen more or less distinctly marked irregular brown rings, of which four are antecitellial, two citellial, and the remainder postcitellial. Brown, more or less conspicuously, predominates to the twelfth ring, posterior to which the pale background increases. Several annuli in the neighborhood of the anus are always pale.

The four precitellial rings show a strong tendency to fuse both dorsally and ventrally (more particularly the latter), sometimes the first three, sometimes the last three, or all four being thus united. The dorsal pigmentation then tends to split up into three yellow and two brown longitudinal lines, the latter being usually predominant. There is always a complete white ring just anterior to the clitellum. The clitellum is heavily pigmented above; and below, especially in the middle region, is almost devoid of color. The pattern is longitudinal. There is a rather broad median yellow stripe, a brown stripe (composed of two brown and one yellow lines), a very narrow yellow stripe, and then heavy brown blotches which cover the sides. A pale postcitellial ring is usually well defined and complete.

In the posterior region the blotches are large, well defined, irregular, and asymmetrical, and not distinctly metameric in arrangement. A tendency is manifest on the ventral surface to break up into a median series of confluent blotches, on each side of which is a narrow, ill-

defined, yellow, longitudinal line. Laterally the blotches are enlarged, dorsally they are narrower, but on each side of the middle line are again drawn out and frequently become longitudinally confluent. Except in one specimen, the dorsal median yellow line is scarcely interrupted. The twelfth brown annulus is continuous across it in all four specimens, and the following ones show somewhat of a similar tendency. In two specimens the paired dorsal brown stripes may be traced almost without break for the animal's entire length, and it is in one of these that the median yellow stripe is interrupted at almost every brown band. The posterior sucker is heavily pigmented dorsally, less so or almost unpigmented ventrally. The marginal zone is pale, with about fourteen dark and irregular brown rays extending toward it and terminated by as many dark eye spots.

	mm.
Length	19
Breadth	1.8
Length of anterior region	4.
Length of head (above)5
Breadth of head7
Diameter of acetabulum	1.6
Breadth of clitellum	1.5

Types.—No. 4818, U.S.N.M. Arichat, Cape Breton, Nova Scotia; W. A. Stearns, 1890, from lips of lamper eel (*Petromyzon marinus*). Four specimens.

16. PISCICOLA RECTANGULATA Levisen.

No. 4705, U.S.N.M. Alaska; Lieut. G. M. Stoney; "fish parasite." Eight specimens.

17. PISCICOLA ANARRHICHÆ.

Ichthyobdella anarrhichæ DIESING.

Ichthyobdella anarrhichæ VAN BENEDEN and HESSE.

Not *Platybdella anarrhichæ* MALM.

Piscicola marina LEUCKART, 1849.

Piscicola marina GRUBE.

Not *P. marina* JOHNSON.

No. 3958, U.S.N.M. Point Barrow, Alaska. U. S. Signal Service; J. Murdoch; gills of *Lycodes*. Twenty-six specimens.

18. PISCICOLA RAPAX.

Pontobdella rapax VERRILL.

No. 5030, U.S.N.M. Menemsha Bight, Vineyard Sound, Massachusetts. U. S. Fish Commission, 1883; August 28; exterior of *Pleuronectes dentatus*. Four specimens.

PONTOBDELLA Leach.

19. PONTOBDELLA MURICATA (Linnæus) Moquin-Tandon.

No. 175, U.S.N.M. (no further data). One specimen.

No. 773, U.S.N.M. Cedar Keys, Florida; Henry Hemphill, December, 1883; from tongue of large shark. One specimen.

Family HIRUDINIDÆ.

HAEMOPIS SAVIGNY.

24. HAEMOPIS MARMORATIS.

Hirudo marmorata SAY.

Not *Nepheleis marmorata* VERBILL.

Aulastomum lacustre LEIDY.

Semisclex grandis VERRILL.

This determination was made by the examination of what are probably Say's types, recently discovered in the collection of the Philadelphia Academy. Say's species differs from *H. sanguisuga* Linnaeus chiefly in the constitution of somite VI, which in the latter species has, according to Whitman's figure (7), the three annuli of equal size and without indication of subdivision. *H. marmoratis*, on the other hand, has the second and third annuli (twelve and thirteen of the entire series) much wider than the first, and each completely divided into two by a distinct sulcus. The genital pores vary slightly in position, as indicated by the conflicting descriptions of Leidy and Verrill. The male pore is usually situated at the anterior border of annulus thirty-one and the female in thirty-six.

No. 5033, U.S.N.M. Yellowstone Park; C. Hart Merriam; Hayden's expedition, 1872. Eleven specimens.

No. 670, U.S.N.M. Havre de Grace; Milner, 1877. Three specimens. This is var. *trigris* Verrill.

No. 5034, U.S.N.M. Marsh, Leavenworth County, Kansas; Orsen Pattee. One specimen.

No. 4498, U.S.N.M. Bristol Bay, Alaska; C. L. McRay, September 27, 1883. One specimen.

25. HAEMOPIS LATERALIS.

Hirudo lateralis SAY.

Semisclex terrestris FORBES.

The type of Say's species was recently discovered in the collection of the Philadelphia Academy.

The sixth somite of *H. lateralis* consists of five annuli; the sexual pores are consequently two annuli further back than in *H. marmoratis*. Say's specimens were all aquatic, Forbes's all terrestrial.

No. 4102, U.S.N.M. Olney, Illinois; July, 1885; J. and C. Walker. One specimen.

No. 625, U.S.N.M. Keelfoot Lake (small creek), near Idlewild Hotel, Obion County, Tennessee; Ed. Palmer; 1882. One specimen.

LIMNOBELLA R. Blanchard.

26. LIMNOBELLA MEXICANA R. Blanchard.

No. 202, U.S.N.M. Quanaajuata, Mexico; Prof. A. Dugès. Three specimens.

MACROBDELLA Verrill.

Not *Macrobdella* PHILIPPI.

Verrill's use of *Macrobdella* seems to have priority, his paper having been published in February, 1872, while Philippi's was not published until October of that year.

27. MACROBDELLA DECORA (Say) Verrill.

Hirudo decora SAY.

Hirudo decora LEIDY.

No. 4599, U.S.N.M. Wytheville, Virginia; Col. M. McDonald, U. S. Fish Commission. Two specimens.

No. 4503, U.S.N.M. Fulton Lakes, Adirondacks; Fred. Mather, July 2, 1882. Thirteen specimens.

PHILOBDELLA Verrill.

Verrill established *Philobdella* as a subgenus of *Macrobdella*, though he inclined to raise it to the rank of a full genus, which is undoubtedly its proper systematic value. The most remarkable character of the genus is that the ducts of both male and female organs open externally within the limits of somite XI. The sexual adhesive organs are arranged around these pores.

28. PHILOBDELLA FLORIDANA Verrill.

The chief points in the annulation of this species are shown in the following table:

Annulation of *Philobdella floridana*.

Somites.	Annuli.	Organs.
	<i>Prostomium.</i>	
I	1	First pair of eyes.
II	2	Second pair of eyes.
III	3	Third pair of eyes.
	4	
IV	5	Fourth pair of eyes.
	6 united ventrally.	
	7 united ventrally.	
	8	Fifth pair of eyes.
V	9	
	10	
	11	
VI	12	
	13	First pair nephridiopores on posterior margin of 13.
VII	14 to 18	Second pair nephridiopores on posterior margin of 18.
VIII to X	19 to 33	Third to fifth pairs of nephridiopores on 23, 28, and 33.
	34	Male pore on 34.
	35	
XI	36	
	37	Female pore on 37.
	38	Sixth pair of nephridiopores on 38.
XII to XXII	39 to 93	Seventh to seventeenth and last pair of nephridiopores on 43 to 93.
	94	
XXIII	95	
	96	
XXIV	97	
	98	
XXV	99	
	100	
XXVI	101	
	102	
Not defined externally.	partly united	Anus.
		Posterior sucker.

Unfortunately no material is available for a study of the internal reproductive organs. The external arrangement is as follows: The median region of annuli thirty-four and thirty-five is pushed in to form a deep pit, which at its mouth is about 2 mm. across. It inclines cephalad and narrows toward the fundus. In one specimen it is at least 2.5 mm. deep. In the front wall, which corresponds to the inturned part of annulus thirty-four, is an orifice which appears to be the male pore. This is located more than a millimeter from the mouth of the pit and between a pair of glandular folds or papillæ, which, like those described below, has each a pore at its summit. Five additional adhesive organs are related to the male pore. A pair is located on the posterior margin of thirty-three, close to the median line. The papillæ are low and wide, and the pores large, oblique, and crescentic. A second pair is placed at the sides of the pit, just within its mouth and close to the posterior wall. A fifth and unpaired organ is placed on the posterior wall of the pit at a higher (more dorsal) level than the pair.

Behind the male pit a large, conical, sugar-loaf-shaped papilla rises from annuli thirty-six, thirty-seven and thirty-eight. At its slightly pointed summit is the female pore, within the limits of the thirty-seventh annulus. The papillæ incline slightly toward the posterior end of the body. On each side of the female pore and rather toward the posterior face of the papilla is an adhesive organ which in copulation would meet one of the pair between which the male pore is situated. Three more, a pair at the base and a single median one higher up, are found on the anterior face of the papilla, and in copulation would attach to the three in the posterior region of the male pit. Another pair is located on annulus thirty-eight, just outside of the base of the papilla, and corresponds to the male pair on annulus thirty-three. In addition to these there is a conspicuous pair farther out on thirty-eight, and on the posterior portion of thirty-nine (or on thirty-nine and forty of one specimen) a bilobed papilla with two pores on one side, and a linear trilobed one with three pores on the other side of the middle line, which have no visible counterpart in the male system. This last group alone probably corresponds to the similar organ of *Macrobdella*, the others being unrepresented in that genus.

All of these organs consist essentially of more or less prominent papillæ containing glandular sacs which open by apical pores, and whose cavities frequently contain hardened masses of mucus.

No. 4103, U.S.N.M. New Orleans, Louisiana; Dr. R. W. Shufeldt (No. 593), 1883, one specimen.

No. 4104, U.S.N.M. New Orleans, Louisiana; April, 1883; Dr. R. W. Shufeldt (No. 1140), one specimen.

No. 791, U.S.N.M. New Orleans, Louisiana; April, 1883; Dr. R. W. Shufeldt (No. 1139), one specimen.

GEOBDELLA Whitman.

Not *Geobdella* BLAINVILLE.*Chthonobdella* GRUBE (in part).

The earlier use of *Geobdella* by Blainville to designate a different group of leeches will of course prevent its general use by systematists in the connection proposed by Whitman.

28. GEOBDELLA LIMBATA (Grube Whitman.

No. 173, U.S.N.M. New Zealand; U. S. Exploring Expedition; one specimen.

No. 174, U.S.N.M. New Zealand; U. S. Exploring Expedition; one specimen.

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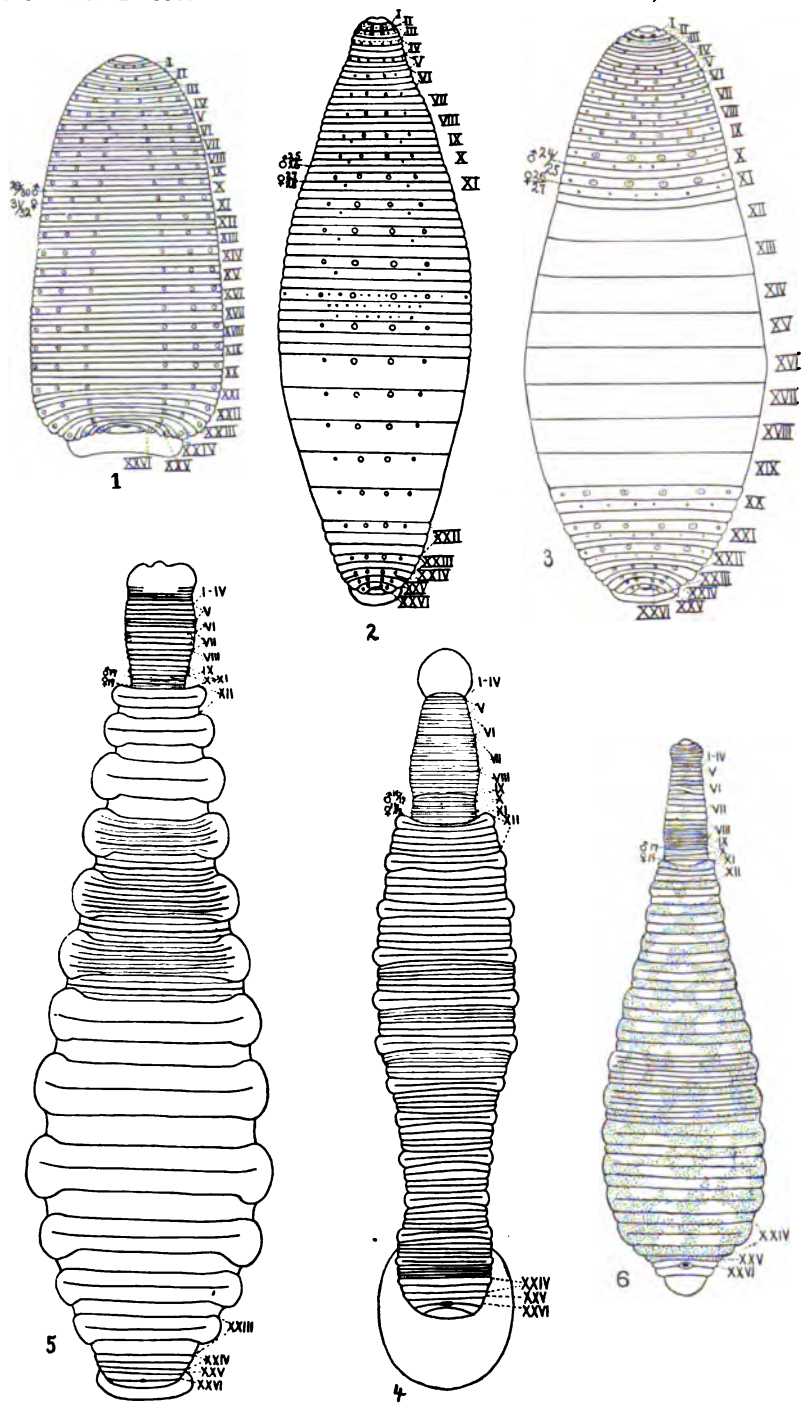
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EXPLANATION OF PLATE.

Plate XL.

- Fig. 1. *Protoclepsine saxiculata*. General morphology of dorsal surface. x 10. The segmentation and arrangement of the papillæ is shown for all the somites.
2. *Glossiphonia mollissima*. General morphology of dorsal surface. x 5. The annuli are omitted from several of the somites of the middle region. The characteristic and principal sensory papillæ are shown for all of the somites, but the smaller and variable ones fully on somite XVI only.
 3. *Placobdella mexicana*. General morphology of dorsal surface. x 5. The characters of the anterior and posterior ends of the body only are shown.
 4. *Trachelobdella ravidus*. General morphology of dorsal surface. x 5. The tertiary annuli are shown for somites XV-XVII.
 5. *Trachelobdella rugosa*. General morphology of dorsal surface. x 5. The integumental secondary and tertiary annuli of the middle region are shown only in somites XV-XVII.
 6. *Trachelobdella maculata*. General morphology of the dorsal surface. x 5. The stippled areas are yellow. Secondary annuli shown in somites XIX and XX.



EXTERNAL MORPHOLOGY OF LEECHES.

FOR EXPLANATION OF PLATE SEE PAGE 563.

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